Effect of Excessive Soil Moisture on the Phytotoxicity of Triallate

Prabhakar R. Thangudu and R.B. McKercher
Department of Soil Science
University of Saskatchewan

ABSTRACT

The growth response of oat (Avena sativa L.) was used to detect triallate (S-(2,3,3-trichloroallyl)diisopropylthiocarbamate) residues in soil incubated at different moisture levels. When the soil was incubated at saturation moisture condition, triallate retained some activity for 30 days even at the lowest rate of application (0.15 kg/ha). Triallate degradation seemed rapid at field capacity moisture levels. Extreme soil moisture conditions favored triallate persistence.

INTRODUCTION

Triallate is a pre-emergence soil applied herbicide used for the control of wild oat (Avena fatua L.) in western Canada. It is used in crops like barley, peas, spring and durum wheat, flax, rapeseed mustard and sugarbeets. It could be applied either in the fall or spring. The trend towards fall application of triallate is increasing as it enables the farmer to use his time efficiently and reduces the use of farm machinery in the field in case of a wet spring. When triallate is fall applied it could be subjected to excessive soil moisture conditions in the following spring due to snowmelt sometimes coupled with early spring rains. This situation could continue for up to a month depending on the weather conditions.

Banting (2) reported that triallate retained some activity for long periods in dry soil. Smith (5) postulated that microbial breakdown of triallate increases as the soil moisture content increases from air-dryness to field capacity. To date little information has been published on the activity of triallate under conditions of soil saturation.

The present study was undertaken to determine the effect of soil saturation on the persistence of triallate.

MATERIALS AND METHODS

Elstow soil was used in these experiments. The average composition of this soil is 30.3% clay, 36.5% silt and 33.2% sand. The organic matter of the soil is 4.8% and pH is 6.7. Percentage moisture at field capacity and saturation is 20 and 48%, respectively. Surface soil was collected, air-dried and ground to pass a 2 mm sieve.
Incubations: The weight of Elstow soil required to fill 5" pots to a depth of 5 cm was determined to be 500 g on air-dry basis. Weighed amounts of air-dry soil were taken in plastic containers and commercial formulation of triallate (emulsifiable concentrate 4 lb/Imp. gal, Monsanto) were added at rates ranging from 0 to 0.35 kg/ha. The soils were thoroughly mixed and distilled water was added to bring the soil to moisture levels ranging from 15 to 48% (representing 75% of field capacity to saturation). The containers were placed in constant

temperature room for incubation at 25 C. Enough containers were incubated to assay soils at two periods (15 and 30 days).
Preparation of Soil: At the end of incubation the soils were spread on polyethylene sheets for two days for drying. They were then ground and distilled water was added to bring the soils uniformly to 15% moisture.
Preparation of Pots: Untreated 500 g soil was weighed into 5"pots and distilled water was added to bring the soils to field capacity. Polyethylene sheet was placed on the top and eight drinking straws of 4 mm diameter and 15 mm long were pierced through the polyethylene into the soil. Eight pregerminated oat seeds were placed in the straws. The seeds were covered with the triallate treated soils from incubation. The pots were placed in the growth chamber. The oats were grown for 15 days at a temperature of 21 C during 18 hr day (16.1 klux) and 16 C during 6 hr darkness.

A separate experiment was conducted to assess the phytotoxicity of triallate at 0.15, 0.25, and 0.35 kg/ha at the beginning of the soil incubation.

The plants were harvested after 15 days. Dry weight of the plants was obtained.

RESULTS AND DISCUSSION

The persistence of triallate was determined by comparing plant dry weights obtained at the initiation of the incubation with those obtained after the two periods of incubation. These are presented in Tables 1, 2 and 3. Triallate degraded gradually with time as assessed by plant dry weights. It is more so at field capacity moisture than at 5% less than field capacity or at saturation. It is noticeable that the loss of phytotoxicity was rapid at field capacity moisture content at all rates of triallate concentration. Considering, for instance, the lowest rate (0.15 kg/ha), it would appear that triallate remained phytotoxic at soil saturation even after 30 days of soil incubation at 25 C.

The data at the lower moisture are in accordance with the finding of Banting (2) who reported that triallate remained active for longer periods in dry soil. McKercher et al. (4) reported that phytotoxicity of triallate did not change even after 20 weeks of soil incubation. The concentration of triallate used in those experiments may not have been low enough to indicate losses by bioassay.

Available data indicate that soil microorganisms contribute significantly to the disappearance of triallate when incorporated in soil (2,5,6). It is also known that there is a direct relationship between the rate of triallate degradation and the soil moisture content up to field capacity (5). The present studies indicate longer persistence of triallate at moisture levels exceeding field capacity and reaching saturation. These moisture levels promote conditions of poor aeration (3). Under these conditions triallate appeared to sustain phytotoxicity for longer periods of time.

When triallate is fall applied and conditions of soil saturation

Table 1. Phytotoxicity of triallate at the initiation of soil incubation as expressed by plant dry matter.

	Concentration of triallate (kg/ha)			
	0	0.15	0.25	0.35
Plant dry weight (g)	0.80	0.22	0.06	0.02

Table 2. Phytotoxicity of triallate after 15 days of soil incubation as expressed by plant dry matter.

Incubation Moisture* (%)	Concentration of triallate (kg/ha)			
	0	0.15	0.25	0.35
	dry weight g**			
15	1.28a	1.13a	0.19ab	0.03a
20	1.17a	1.16a	0.31b	0.06a
34	1.24a	0.90b	0.10a	0.05a
48	1.20a	0.19c	0.06a	0.04a

* 15% - 75% field capacity; 20% - field capacity; 48% soil saturation

** Means followed by the same letter within each herbicide concentration are not significantly different at 5% level according to Duncan's multiple range test.

Table 3. Phytotoxicity of triallate after 30 days of soil incubation as expressed by plant dry matter.

Incubation Moisture* (%)	Concentration of triallate (kg/ha)			
	0	0.15	0.25	0.35
	dry weight g**			
15	0.92a	0.89a	0.35a	0.11a
20	0.89a	0.92a	0.46a	0.45b
34	0.92a	0.92a	0.66a	0.50b
48	0.89a	0.76b	0.50a	0.07a

* 15% - 75% field capacity; 20% - field capacity; 48% soil saturation

** Means followed by the same letter within each herbicide concentration are not significantly different at 5% level according to Duncan's multiple range test.

exist in the spring, seeding may be delayed for a period of time. Triallate remains inactive at low temperatures (1) that prevail in the spring and so will be wild oat seeds. When the temperatures rise, both wild oat and triallate resume activity. Seeding operations provide good conditions for the germination of wild oat seeds. The practical implication of the greater persistence of triallate at higher soil moistures is that it could extend effectiveness of the treatment. However, this needs confirmation from field experiments.

LITERATURE CITED

1. Anonymous. 1975. Monsanto.

2. Banting, J.D. 1967. Factors affecting the activity of diallate and triallate. Weed Res. 7:302-315.

3. Buckman, H.O., and N.C. Brady. The nature and properties of soils. Seventh Edition. Chapter 7, p. 172. The Macmillan Company 1969.

4. McKercher, R.B., R. Ashford, and R.E. Morgan. 1975. Effects of triallate on wild oat grown in a growth chamber. Weed Sci. 23:283-285.

5. Smith, A.E. 1969. Factors affecting the loss of triallate from soils. 9:306-313.

6. Smith, A.E. 1970. Degradation, adsorption and volatility of diallate and triallate in prairie soils. Weed Res. 10:331-339.